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BIOLOGICAL AND MORPHOLOGICAL DISTINCTNESS OF A PREVIOUSLY UNDESCRIBED SPECIES OF THE *PEROMYSCUS TRUEI* GROUP FROM TEXAS

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INTRODUCTION

STOCKS of mice that superficially resemble the brush mouse (*Peromyscus boylii*) were collected in 1932 and 1933 by M. F. Landwer from Tule Canyon, Briscoe County, and from Cooper's Canyon, Garza County, Texas. Subsequent breeding tests and the study of skeletal characters at the Laboratory of Vertebrate Biology show that the affinities of these mice lie not with the *boylii* group but with the *truei* group.

Because the Tule Canyon stock was maintained in the laboratory for ten years, it is possible to take into account certain biological as well as strictly morphological data in determining the relationships of this population to already known and described mice of the *truei* group. The Cooper's Canyon stock was not developed as a laboratory stock, and only four skulls and one skin of field-caught individuals are available.

I am indebted to M. F. Landwer for permission to describe this new form, and to W. H. Burt, of the University of Michigan Museum of Zoology, for making available certain field-killed specimens. I am indebted to H. H. T. Jackson, of the United States Fish and Wildlife Service, for the loan of topotypes of *Peromyscus nasutus* from the collection under his care. The matings of the laboratory mice were made under the direction of L. R. Dice, who also made the body measurements. The cytological preparations and determinations were made by Ray Moree, of the University of Michigan Department of Zoology. Skeletal measurements were made by S. L. Bellanca and by myself. Statistical calculations were made by D. M. Clarke, Bruce Kirchenbaum, and myself.

ISOLATION OF THE TEXAS POPULATION

The population of mice of which the Tule Canyon and Cooper's Canyon stocks are samples probably occupies only a restricted range on the rocky, cedar-covered slopes along the "Break of the Plains" in western Texas. This population lives more than one hundred miles from the nearest other known population of mice of the *truei* group. The nearest known specimens of *nasutus* have been recorded from Tucumcari, Quay County, New Mexico (Bailey, 1931: 157), and *truei* and *nasutus* have been taken in the extreme northwestern corner of the Oklahoma Panhandle (Blair, 1939: 122).

In New Mexico, both *truei* and *nasutus* are mostly restricted to the sabinal and montane life belts of the mountain slopes, where they are most abundant in the pinyon-juniper association (Dice, 1942: 205). In New Mexico, both *truei* and *nasutus* range short distances on the desert grasslands, but nowhere have they been found more than two or three miles from the base of the mountains (Blair, 1941: 226). Therefore, the more than one hundred miles of treeless, relatively level, relatively rockless, short-grass plains lying between the Texas population and the nearest populations of *truei* and *nasutus* must be an effective barrier.

FERTILITY RELATIONS

The Tule Canyon mice can be crossed in the laboratory with *nasutus* from Arizona and New Mexico, although not without some difficulty. Five of twenty matings between Tule Canyon mice and *nasutus* were successful, and resulted in the production of seven male and two female hybrids. The percentage of successful matings in this cross was somewhat smaller than in the pure stocks. Among thirty-one matings within the stock of *nasutus* from Lincoln, New Mexico, only twelve (39 per cent) were productive. The matings within the Tule Canyon stock were more successful, for fourteen (74 per cent) of nineteen matings produced young. The fact that the cross matings were less successful than the matings within the stocks suggests, but does not necessarily prove, partial infertility between the Tule Canyon mice and *nasutus*.

Six of the F_1 male hybrids were mated with Tule Canyon females, and one of these matings resulted in the birth of one male and one female offspring. Three of the F_1 males were mated unsuccessfully to *nasutus* females. One F_1 female hybrid was mated unsuccessfully with a Tule Canyon male. The fact that only one back-cross mating produced young suggests that there was lowered fertility of the hybrids.

Cytological examination of the testes of the hybrid males affords positive evidence of partial infertility between the Tule Canyon mice and *nasutus*. The testes of four F_1 hybrid males that did not reproduce were prepared and examined by Ray Moree. In one animal, spermatogenesis appeared to be going on more or less normally, and there was an abundance of normal as well as some abnormal sperm. Moree believes that this animal was potentially fertile. The three others examined all showed abnormalities in development. No normal sperm were found in any of them, but a few abnormal young sperm were present in each. Moree classifies these animals as of a sterile type. According to Moree, "the general situation in the Tule Canyon hybrids parallels very closely, if not identically, that found in *truei-nasutus* hybrids." Moree plans to publish a detailed description of the cytological conditions of the hybrids between the Tule Canyon mice and *nasutus*.

According to the evidence the Tule Canyon mice are incompletely fertile with mice of the species *nasutus*. The partial infertility is due, in part at least, to gross disturbances in spermatogenesis. Unfortunately, no attempts were made to cross the Tule Canyon mice with *truei*, which is also partly fertile in crosses with *nasutus*. Nine attempted crosses with mice of the *boylii* group proved unsuccessful.

MORPHOLOGICAL DISTINCTNESS OF THE TEXAS MICE

Laboratory-bred animals of known age provide the only critical means of comparing the Tule Canyon mice morphologically with other mice of the *truei* group. For these comparisons, mice of the one-year age class (36–78 weeks) from the Tule Canyon stock, *nasutus* from Lincoln, Lincoln County, New Mexico, and *truei*, from Capitan Gap, Lincoln County, New Mexico, have been used. Means and standard errors of four body and eleven skeletal measurements have been computed (Table I). The body measurements and the first five skeletal measurements in Table I are standard measurements (Dice, 1932: 5). The others need explanation. The interparietal length is the greatest length, and the interparietal width is the greatest width of that bone. The length of the bulla is its greatest length. The width of the bulla is measured just anterior to the thickened base of the external auditory meatus; this is not the greatest width. The parietal-bullar depth is measured from the median surface of the skull just anterior to the interparietal to the plane of the most inflated parts of the two auditory bullae. The nasal length is the greatest length along the suture between the two nasals. Of bilateral structures, the left member is measured. Means of the same measurements of field-killed Tule Canyon mice and field-killed topotypes of *nasutus* have been included in the table. These field-killed animals are of little use, however, because of their small numbers, unknown ages, and because the body measurements were made by different collectors.

In comparing the two means, the difference between them is considered to be significant if it is 2.7 or more times its standard error.

The Tule Canyon mice are significantly smaller than either *truei* or *nasutus* in a majority of the measurements. They are smaller than *nasutus* in tail length, foot length, femur length, length of mandible, condyle-premaxillary distance, condyle-zygoma distance, length of interparietal, and parietal-bullar depth. They are significantly smaller than *truei* in body

TABLE I

MEASUREMENTS OF *Peromyscus comanche, P. nasutus,* AND *P. truei*
Means and standard errors, in millimeters

Stock	No.	Mean Age in Weeks	Parents	Body Length	Tail Length	Foot Length	Ear Length
Laboratory-bred, 1-year class							
nasutus, Lincoln	64	52	7	104.89 ± .37	103.73 ± .61	23.275 ± .064	22.435 ± .096
comanche, Tule Canyon	54	53	6	104.11 ± .44	100.21 ± .59	22.520 ± .097	22.196 ± .122
truei, Capitan Gap	79	54	8	107.53 ± .40	94.17 ± .73	22.977 ± .069	25.196 ± .086
Field-killed							
nasutus, Estes Park	2	......	......	97.50	97.00	23.000	......
comanche, Tule Canyon	10	......	......	88.22	100.11	21.967	......

Stock	Length of Femur	Length of Mandible	Condyle-Premaxilla	Condyle-Zygoma	Bullar Width of Skull
Laboratory-bred, 1-year class					
nasutus, Lincoln	18.234 ± .066	17.562 ± .052	27.266 ± .066	19.374 ± .052	12.206 ± .040
comanche, Tule Canyon	17.900 ± .061	16.898 ± .060	26.620 ± .076	18.962 ± .053	12.124 ± .040
truei, Capitan Gap	19.156 ± .087	17.228 ± .043	27.052 ± .063	19.283 ± .046	12.435 ± .030
Field-killed					
nasutus, Estes Park	......	17.750	26.600	19.000	12.200
comanche, Tule Canyon	......	16.220	25.370	18.330	11.970

Stock	Interparietal Length	Interparietal Width	Length of Bulla	Width of Bulla	Parietal-Bullar Depth	Nasal Length
Laboratory-bred, 1-year class						
nasutus, Lincoln	10.680 ± .061	3.871 ± .038	5.153 ± .023	2.824 ± .024	10.260 ± .030	11.341 ± .040
comanche, Tule Canyon	9.952 ± .082	4.008 ± .164	5.340 ± .028	3.335 ± .025	9.958 ± .030	11.258 ± .165
truei, Capitan Gap	10.343 ± .051	3.608 ± .035	5.720 ± .018	3.424 ± .017	10.271 ± .032	11.223 ± .035
Field-killed						
nasutus, Estes Park	10.700	3.650	4.900	3.050	10.000	10.750
comanche, Tule Canyon	10.000	3.990	5.170	3.140	9.700	10.510

length, foot length, ear length, femur length, length of mandible, condyle-premaxillary distance, condyle-zygoma distance, bullar width of skull, length of interparietal, length of bulla, and parietal-bullar depth.

In only two measurements, length of bulla and width of bulla, are the Tule Canyon mice significantly larger than is *nasutus*. In only one measurement, tail length, are they significantly larger than *truei*.

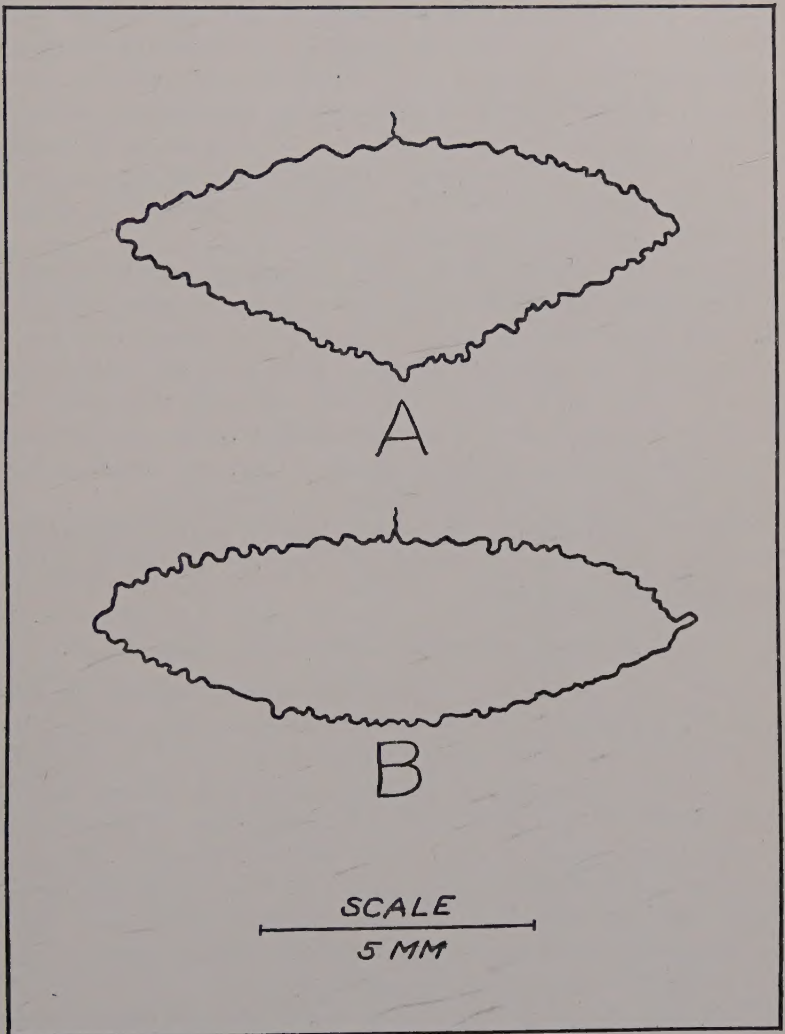

FIG. 1. Interparietal bone of *Peromyscus comanche* (A) aged forty-eight weeks, from the Tule Canyon, Texas, stock and of *Peromyscus nasutus* (B) aged fifty-one weeks, from the Lincoln, New Mexico, stock.

The Tule Canyon mice do not differ significantly from *nasutus* in body length, ear length, bullar width of skull, width of interparietal, or nasal length. They do not differ from *truei* in width of interparietal, width of bulla, or nasal length.

The principal characters by which *truei* and *nasutus* may be separated are the larger ears, larger auditory bullae, and shorter tail of *truei*. By use of these characters mature *truei* and *nasutus* may be readily separated. In all of these characters the Tule Canyon mice are much more like *nasutus* than like *truei,* which shows them to be more closely related to the former than to the latter.

The most conspicuous skeletal difference between *nasutus* and the Tule Canyon mice is in the shape of the interparietal. This bone is roughly elliptical in *nasutus,* but it is triangular in the Tule Canyon mice (Fig. 1). The two species nearly always can be separated by examination of the interparietal, which has much the same shape in *truei* as in the Tule Canyon mice, so that it would be impossible to separate the two on this character alone. The interparietal in *truei* seems to be more variable in shape than in either *nasutus* or in the Tule Canyon mice.

In pelage color the Tule Canyon mice differ from *nasutus* in much the same way that *truei* does. Tule Canyon mice of the one-year class are more brightly buffy than are specimens of *nasutus* of comparable age from Lincoln and from Capitan, New Mexico. Like *truei* but unlike *nasutus,* they have also a lateral stripe of buffy hairs unmixed with gray. Field-killed Tule Canyon mice likewise are more buffy than are field-killed specimens of *nasutus* from Estes Park and Manitou, Colorado, and from Kenton, Oklahoma, and unlike them, have a noticeable lateral stripe.

The Cooper's Canyon mice have slightly smaller auditory bullae than do the mice from Tule Canyon. Otherwise, they are morphologically very much like the Tule Canyon mice.

EVOLUTIONARY STATUS OF THE TEXAS MICE

The three separate breeding arrays that are represented by *nasutus, truei,* and the Texas mice demonstrate two stages in the differentiation of a species from a previously interbreeding population. The populations known as *nasutus* and *truei* have, in some manner and at some time in the past, split into discrete breeding arrays. The divergence of these two populations, presumably through differential mutation pressure and selection pressure, now has reached the point where (1) there is partial infertility between the two; (2) the two kinds occur together in the same ecological associations without interbreeding; and (3) the two are readily separable because of conspicuous morphological differences.

The Texas population and the species *nasutus* are also isolated arrays of a presumably previously interbreeding population. The Tule Canyon mice, like *truei,* have developed partial infertility with *nasutus.* They, too, are prevented from interbreeding with *nasutus,* although in this case by a geographical barrier. They and *nasutus* also have drifted apart morphologically to the point where most individuals of the two kinds may be readily separated on structural characters.

The Texas mice and *nasutus* seem to have been separated a shorter time than have *nasutus* and *truei* for two reasons. First, there is good reason to believe that geographic isolation usually is the first critical step in speciation. After geographic isolation has permitted the random divergence of the previously interbreeding populations, the differentiating kinds may again come to occupy the same areas and the same ecological associations without interbreeding. The Texas mice have obviously reached only the stage of geographic isolation, while the *truei* and *nasutus* have passed this stage and have come to occupy in some places common ranges and common ecological associations. Second, the morphological differences between *nasutus* and the Texas mice are not quite so great as those between *nasutus* and *truei.*

The *truei* species group, as now known, is made up of three discrete breeding arrays, no one of which, however, is completely infertile with the others. This species group corresponds to my concept of a cenospecies (see Blair, in press), for the three breeding arrays are at least partly fertile *inter se* but infertile with other cenospecies. In classification, the Texas population of mice must rank as a taxonomic species, just as do *truei* and *nasutus.* This species may be described as follows.

Peromyscus comanche, new species

The Texas Juniper-mouse

TYPE.—Female adult, skull and skin; Univ. Mich. Mus. Zool. No. 66901; from Tule Canyon, Briscoe County, Texas, about 22 miles east of Tulia; May 23, 1932; collected by M. F. Landwer; original number, 237.

GEOGRAPHIC DISTRIBUTION.—Known only from the type locality and from Cooper's Canyon, four miles southwest of Post, Garza County. Probably occurs in other canyons along the Break of the Plains in northwestern Texas.

CHARACTERS.—Ears and bullae much smaller than in *truei;* tail longer than in *truei.* Interparietal triangular rather than elliptical as in *nasutus.* Pelage brighter than in *nasutus,* with a pronounced lateral line of buffy hairs unmixed with gray. Skull larger and braincase more inflated than in *boylii,* with much larger auditory bullae.

MEASUREMENTS OF TYPE (in mm.).—Total length, 206; tail vertebrae, 107; hind foot, 22.0; ear from notch, 21.0. Skeleton: greatest length of skull, 28.5; basilar length of Hensel, 21.0; zygomatic breadth, 14.0; interorbital constriction, 4.5; length of interparietal, 9.7; width of interparietal, 3.8; length of nasals, 11.0; shelf of bony palate, 4.1; palatine slits, 5.5; diastema, 7.0; postpalatal length, 10.1; maxillary tooth row, 4.2; condyle-premaxilla distance, 26.7; condyle-zygoma distance, 19.0; bullar width of skull, 12.3; length of bulla, 5.4; width of bulla, 3.3; parietal-bullar depth, 10.0.

COLOR (worn pelage refers to type; unworn to laboratory raised animals).—Ground color of dorsal pelage Ochraceous Buff[1] mixed with dusky, fading into Light Ochraceous Buff in worn pelage. There is a pronounced lateral line of Ochraceous Buff unmixed with dusky. General effect above of Cinnamon or Tawny Olive in unworn pelage, changing to Wood Brown in worn pelage. Sides of face and nose grayish. Ears dusky. Tail more or less sharply bicolor. Feet and underparts white.

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[1] Capitalized color terms are after Ridgway (1912).

SPECIMENS EXAMINED.—*Peromyscus comanche:* Tule Canyon, Briscoe Co., Texas, 92; Cooper's Canyon, Garza Co., Texas, 4. *P. n. nasutus:* Lincoln, Lincoln Co., New Mexico, 65; Capitan, Lincoln Co., New Mexico, 13; Estes Park, Larimer Co., Colorado, 4; Manitou, El Paso Co., Colorado, 5; Taft Canyon, Cimarron Co., Oklahoma, 1. *P. t. truei:* Capitan Gap, Lincoln Co., New Mexico, 80. *P. boylii attwateri:* New Braunfels, Comal Co., Texas, 4. *P. boylii rowleyi:* Summerhaven, Pima Co., Arizona, 14.

SUMMARY

A population of mice of the *Peromyscus truei* group living in Tule Canyon and adjacent canyons along the Break of the Plains in Texas is geographically isolated from other mice of the same species group. The Tule Canyon mice are only partly fertile in crosses with specimens of *nasutus* of the *truei* group. Morphologically, they are more like *nasutus* than *truei*, but they differ considerably from *nasutus* both in skeletal structure and in external appearance. The Tule Canyon mice are here described as a new species, *Peromyscus comanche*, of the *truei* group.

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